WHAT IS CLAIMED IS:

1. A continuous, flexible cylindrical device for detecting acoustic signals, comprising:

a flexible core including an acoustic substrate;

an optical fiber wound around the acoustic substrate; and

at least one periodic refractive index perturbation formed in the optical fiber.

2. The device of claim 1, wherein the acoustic substrate contains a plurality of voids.

3. The device of claim 2, wherein the voids are formed by hollow microspheres.

4. The device of claim 3, wherein the microspheres are formed from a compliant material.

5. The device of claim 1, wherein the flexible core includes a hollow tube for providing a passageway through the core.

6. The device of claim 1, wherein the flexible core includes a strength member for providing tensile strength to the core to resist stretching or breaking of the core during deployment, retrieval or use.

7. The device of claim 5, wherein the flexible core includes a strength member surrounding the hollow tube for providing tensile strength to the core to resist stretching or breaking of the core during deployment, retrieval or use.

8. The device of claim 7, further comprising an intermediate jacket disposed between the metal tube and the central strength member.

9. The device of claim 6, further comprising a jacket disposed over the strength member.

10. The device of claim 8, further comprising a jacket disposed over the strength member.

11. The device of claim 1, wherein the acoustic substrate includes a an elastomeric material having a selected dynamic property for limiting the sensor frequency response to within a desired range of frequencies.

12. The device of claim 1, wherein the optical fiber is wound under tension to form at least one optical hydrophone.

13. The device of claim 12, wherein the optical fiber is wound under tension to form a plurality of optical hydrophones, with each of the hydrophones separated by a periodic refractive index perturbation.

14. The device of claim 13, wherein the periodic refractive index perturbation is a Bragg grating.

15. The device of claim 13, wherein the periodic refractive index perturbation is a long period grating.

16. The device of claim 1, further comprising a layer of tape disposed around the acoustic substrate under the optical fiber.

17. The device of claim 16, wherein the tape has a low coefficient of friction relative to a coefficient of friction of the fiber.

18. The device of claim 16, wherein the tape is formed from Teflon.

19. The device of claim 1, further comprising a filler rod, the filler rod inter-wound on the acoustic substrate with the optical fiber such that the filler rod is disposed approximately parallel to the optical fiber .

20. The device of claim 19, wherein the filler rod is formed from nylon.

21. The device of claim 19, wherein the filler rod has a diameter equal to or larger than a diameter of the optical fiber.

22. The device of claim 21, wherein the filler rod and optical fiber are inter-wound around the acoustic substrate so that there is a space between adjacent turns of the wound optical fiber, the space being filled with a compliant material.

23. The device of claim 22, wherein the compliant material is a thermoplastic elastomer.

24. The device of claim 22, wherein the compliant material is depolymerized rubber.

25. The device of claim 23, further comprising a tape layer disposed around the inter-wound filler rod and optical fiber.

26. The device of claim 25, wherein the tape layer is formed from a material having a low coefficient of friction relative to a coefficient of friction of the optical fiber.

27. The device of claim 26, wherein the material is Teflon.

28. The device of claim 26, wherein the material is a polyimide polymer.

29. The device of claim 1, wherein the optical fiber includes an external layer formed from an elastomer.

30. The device of claim 29, wherein the elastomer is void filled.

31. The device of claim 1, further comprising:

an outer tube in which the flexible core and optical fiber are disposed, there also being a space between the outer tube and the flexible core and optical fiber; and

a material disposed within the space, the material for coupling acoustic signals from the outer tube to the flexible core and optical fiber.

32. The device of claim 31, wherein the material is a fluid.

33. The device of claim 31, wherein the material is a low shear modulus polymer.

34. The device of claim 32, wherein the fluid is Isopar.

35. The device of claim 32, wherein the fluid is Norpar.

36. The device of claim 31, further comprising an outer elastomeric layer disposed on the flexible core and optical fiber, the elastomeric layer including hollow microspheres dispersed through the elastomeric layer to adjust buoyancy.

37. The device of claim 31, wherein the material is an elastomeric material having a plurality of microspheres dispersed throughout the elastomeric material for providing pressure-compensated structural support for the flexible core and optical fiber.

38. The device of claim 13, further comprising a ring of low shear material disposed between at least one pair of adjacent optical hydrophones.

39. The device of claim 3, wherein the microspheres are formed from Expancel.